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Measuring crown dynamics of longleaf pine in the sandhills of Eglin Air Force Base

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ABSTRACT: The USDA Forest Service SRS, in cooperation with Auburn University, is developing an individual tree, spatially explicit, and biologically based growth model for natural longleaf pine stands at Eglin Air Force Base in Florida. The goal of the growth model is to provide a tool for the land managers to compare silvicultural practices effects on the light and water environment in addition to stand structure of the trees. Individual trees are being selected within 3 site classes at Eglin, to fit a predetermined matrix of tree height, diameter, and crown ratio. The field data taken on each selected tree includes stem taper on the subject tree and location relative to the subject tree, species, size, and crown dimensions on competitors. Branches and the top of the subject tree are then lowered to the ground before the stem is cut. The stem is then cut into sections and brought back to Auburn for reconstruction. Complete crown architecture for the past three years is measured by reattaching the branches to the stem sections within a three dimensional grid. Disc samples are collected at 1-meter intervals along the stem for measurements of heartwood and sapwood relationships, tree ring growth, and dry wood density. In the field, every fourth branch is selected to be a sample branch from which fresh needles are removed within every meter out from the stem to determine weight, density, length, and nitrogen content. Branch discs are also taken at the base of every sample branch after crown architecture to determine sapwood, branch radial growth, and wood density.

Over 50 trees have been finished so far ranging in diameter from seedlings just out of the grass stage to mature trees over 30 cm in diameter. Other factors such as light penetration through the crown and soil nutrients and water holding capacity are still in the planning stages. Another 1.5 years of data collection will be required to fill out the tree size matrix at which time a preliminary model will be completed for review.

INTRODUCTION

Land managers at Eglin Air Force Base are confronted with the challenge of managing a large, diverse forested area the primary component of which is longleaf pine. As a species, longleaf pine is poorly understood relative to other southern pines. This lack of information about the species is complicated by the unique conditions of the base itself.

Eglin Air Force Base consists of 463,000 acres of land, most of which is forested. The primary mission of the Air Force at Eglin is conventional weapons testing. This creates an environment of frequent low intensity fires favoring seral species similar to the conditions under which area forests developed prior to settlement. Foremost among the tree species represented on the landbase at Eglin are longleaf pine (*Pinus palustris* Mill.), sand pine (*Pinus clausa* (Chapm.) Vasey.), and various scrub oaks (*Quercus* spp.). The soils in which these forests grow are almost entirely excessively well-drained sands such that even though the area receives more rainfall than any other part of Florida the trees are subject to drought-like conditions for most of the summer.

This combination of species mixture and environmental conditions make the forests at Eglin unique. Because of this land managers have few tools to use in evaluating management options. To alleviate this shortcoming, a team of researchers from the USDA Forest Service Southern Research Station and the School of Forestry at Auburn University has begun work at developing Jabberwocky, a spatially explicit individual tree model for longleaf pine.

Jabberwocky has a twofold purpose. The first is to give land managers at Eglin a tool for providing traditional growth and yield information for longleaf pine. The second is to serve as the foundation for an ecosystem model for longleaf pine applicable to conditions encountered throughout the species' range.

Progress

Preliminary work for the project saw the establishment of 107 plots on 25 different stands across the base. On these plots, the location of the trees was mapped and various measurements of size taken. These measurements provided preliminary data by which the sampling frame of candidate trees for more intensive measurement was formed.

Stands across the base were divided among three classes based on site index. A sampling matrix was formed identifying ten size classes based on diameter and crown ratio. Work to date has been in locating trees in each size class and collecting sample material from each on which to make intensive measurements. So far measurements have been taken from trees representing 23 of the 30 different size classes. Less-intensive measurements will be made on at least 120 different trees representing 40 different size classes on the three site quality types after all thirty classes of the preliminary matrix have been filled.

A great amount of data must be collected for development and calibration of the model. Considerable effort has gone into recording and validating measurements and putting them into a format in which they may be used in developing the model. This process is ongoing.

Future Directions

Because current measurement procedures are costly in terms of time and labor required, alternatives are being examined to allow for the measurement of a greater number of trees. Ongoing research seeks to elucidate the relationship between sapwood area and foliage area to develop a predictor of foliage quantity based on sapwood area in accordance with the Pipe Model Theory (Shinozaki et al. 1964). Successful completion of this phase of the project will permit less intensive measurements of the quantity and distribution of foliage in the tree's crown.

Other research will examine the relationship between branch architecture and the size and angle of divergence of a branch from the main stem. Currently, making detailed measurements of the spatial location of each growing point on the tree is the most time-consuming task in the development of the database. After a certain number of trees have been intensively measured, predictors of the size and layout of branches will be developed so that a greater number of trees may be measured less intensively.

LITERATURE CITED

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